

Development Studies of a Novel Wet Oxidation Process

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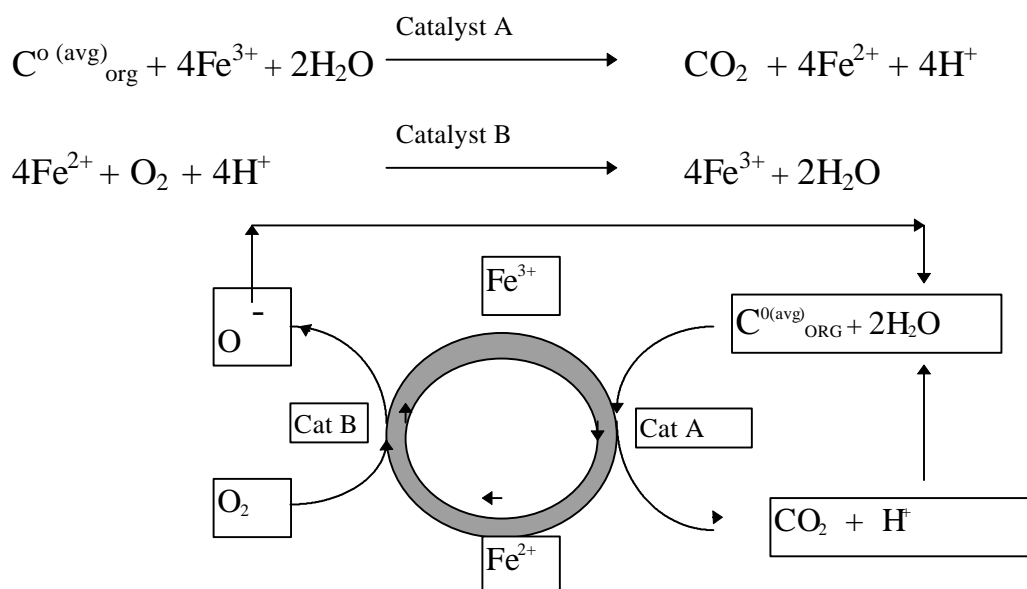
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Introduction

In response to the need for alternative treatment technologies which provide for safer, more efficient, and economical means of treating low level mixed wastes, Delphi has been involved in the development of its patented catalyzed wet oxidation technology (see Figure 1, Process Description) for application to identified radioactive contaminated wastes located at Rocky Flats Environmental Technology Site, Los Alamos National Laboratory, and other DOE sites. Delphi is presently preparing for the Phase IV demonstration of the DETOXSM technology at the Savannah River Site.

Figure 1: Process Description



Objective

The ultimate objective of the project is to design, fabricate, install, and operate a full scale demonstration unit capable of treating organic materials common to DOE Low Level Mixed Wastes (LLMW) inventories. The project is planned to occur in four phases as follows:

Phase I - Laboratory Testing

The objectives for the Phase I effort were to determine the possible range of applications for the DETOXSM process and to develop a conceptual design for a demonstration unit.

Phase II - Demonstration Unit Design and Site Selection

The objectives for the Phase II effort were to conduct a demonstration site survey to determine best sites for demonstrating the process, and perform Title II design of a demonstration unit.

Phase III - Fabrication, Installation, and Shakedown Testing

The objectives for the Phase III effort will be to fabricate and assemble the demonstration unit, install it at the chosen site, and perform shakedown tests to verify that the unit operates properly.

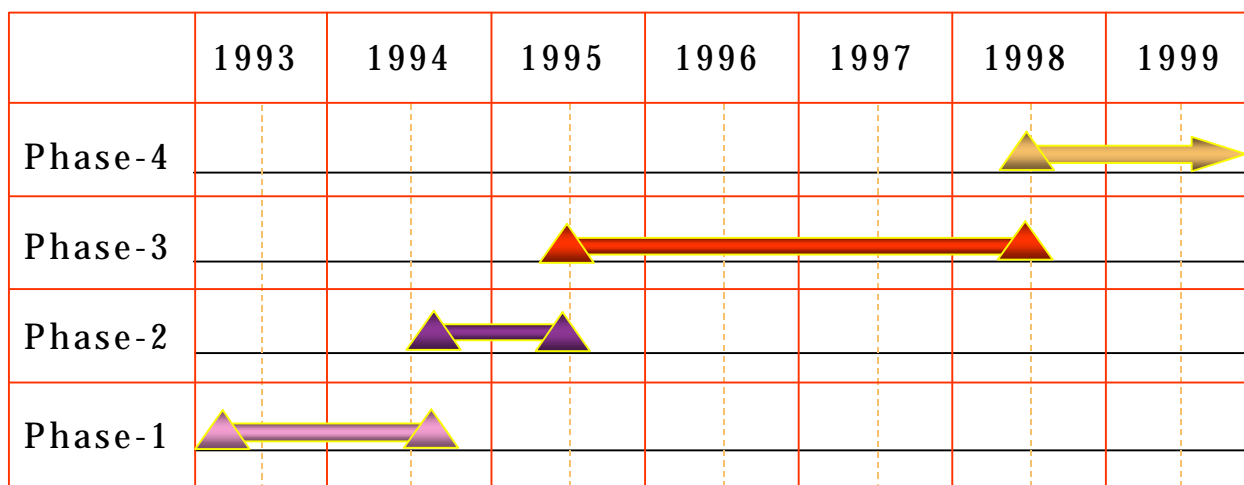
Phase IV - Testing, Validation and Evaluation

The objective for the Phase IV effort will be to conduct validated cold (non-radioactive) and hot (radioactive) tests of the demonstration unit

All phases of the project are shown in Figure 2 (Tasks vs. Time).

Figure 2: Tasks vs. Time

DETOXSM Project Schedule



Results

A 25 kg per hour demonstration unit has been fabricated and installed at the Multipurpose Pilot Plant Campus located at Savannah River Site.

Functionality tests are currently underway and shakedown testing on liquid and solid materials is due to be completed by January 31, 1998.

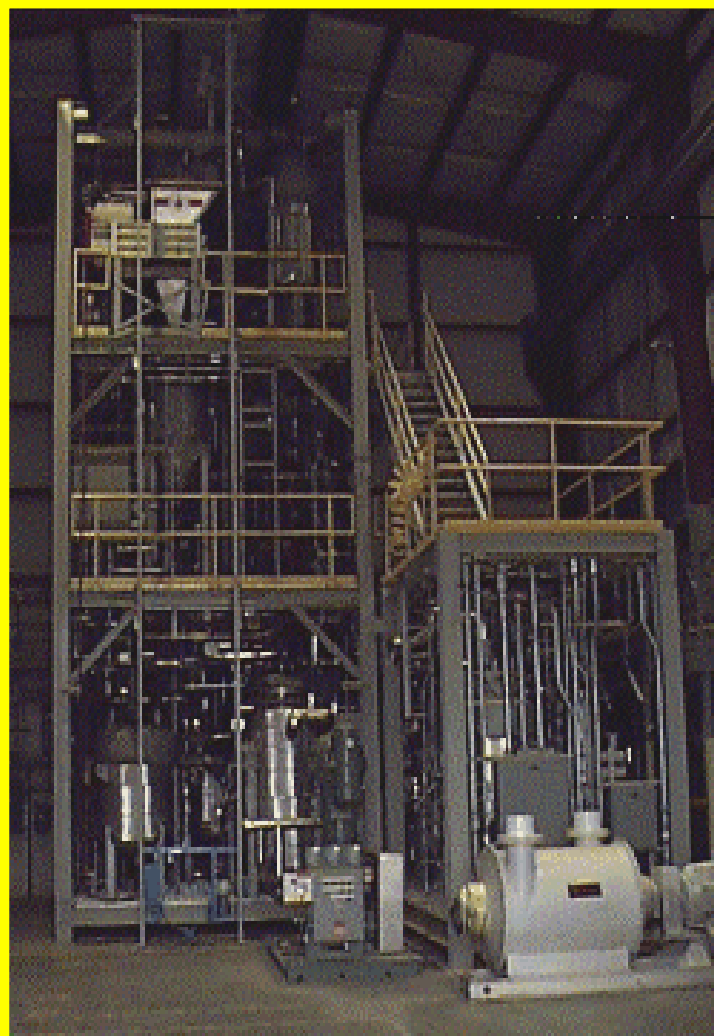
In preparation for the demonstration, permits and exemptions have been secured from the State of South Carolina, Department of Health and Environmental Control to operate under an NPDES permit as a waste water treatment unit. An air emissions exemption has been issued for the demonstration since laboratory tests and emissions models indicate that emissions of hazardous or controlled gases will be well below regulated limits.

A Readiness Review has been completed verifying that Delphi is ready to safely operate and manage the process according to SRS site requirements.

Operating personnel have been trained and certified to meet operational, safety, and hazardous conditions which may be encountered during the demonstration. A unique training tool to identify misinformation and correct it prior to operation has been successfully implemented and is anticipated to significantly reduce human error factors.

Stakeholders have been identified and contacted with regard to the demonstration and the status of commercial availability. Plans are being implemented to allow potential customers and users of the technology to visit the site and observe operations during demonstration.

DETOXSM Demonstration Unit Installed at Savannah River Site



Future Activities

Shakedown testing is planned to be completed by January 31, 1998 and Phase IV is expected to begin in February. The experimental plan calls for the testing of the following materials at SRS in the order in which they appear:

Testing Program	Treated Materials
Shakedown Testing	Mineral oil Combustible solids
Cold Testing	Oil/waste water Non-Halogenated solvents mixture Hydrocount® scintillation fluid TrimSol® Chipped railroad ties Combustible solids Sludge surrogate Contaminated oil surrogate Halogenated solvents

Site Integration Issues

Site Integration issues which have been found to impede the progress of the demonstration are permitting, types of wastes to be treated, installation of the equipment, site agreements and restrictions, and commitments by a LLMW site to host the hot portion of the demonstration. Project experiences are useful to determine what might be changed in future demonstrations to improve schedule, budgets, and customer acceptance.

Permitting and Types of Wastes

The objectives of the demonstration are to obtain operating data on materials similar to actual waste known to be in inventory at DOE sites. In order to successfully commercialize a treatment technology the integrity of the data is a given, but equally important is the type of materials treated. Originally, it was understood that the DETOXSM project would require the use of hazardous materials in the first task of demonstration testing and that radioactive contaminated wastes would be treated subsequent to such tests. Only after commitment was made, fabrication begun, and site integration issues were well defined, was the fact revealed that the site chosen to host the demonstration was restricted from use of listed materials, thus, forcing the purchase of surrogate materials and alteration in permitting strategy from a RCRA RD&D permit to a NPDES permit.

The resulting change in permitting allowed Delphi (1) to proceed with surrogate materials still representing materials commonly found in DOE waste streams, (2) eliminate costly characterization of waste materials, since known quantities of known materials are to be

introduced to the DETOXSM system, and (3) to demonstrate how regulators perceived the technology as a non-polluting system.

Installation of Equipment

In a CRDA agreement with WSRC, the task of offloading and installing the demonstration unit were to be performed by WSRC. Due to budgetary issues, and scheduling conflicts these major tasks were performed by Delphi in order to minimize impacts to the budget and schedule. These unanticipated changes in scope resulted in a 6 month delay to the project while technical reviews, budgets and schedules were reassessed by DOE-FETC, DOE-SR, WSRC, and MWFA. The result of all of this fundamental change in scope was that engineers and technicians were afforded additional opportunity to learn more about the demonstration unit systems and functions than had been previously planned.

Site Agreements and Requirements

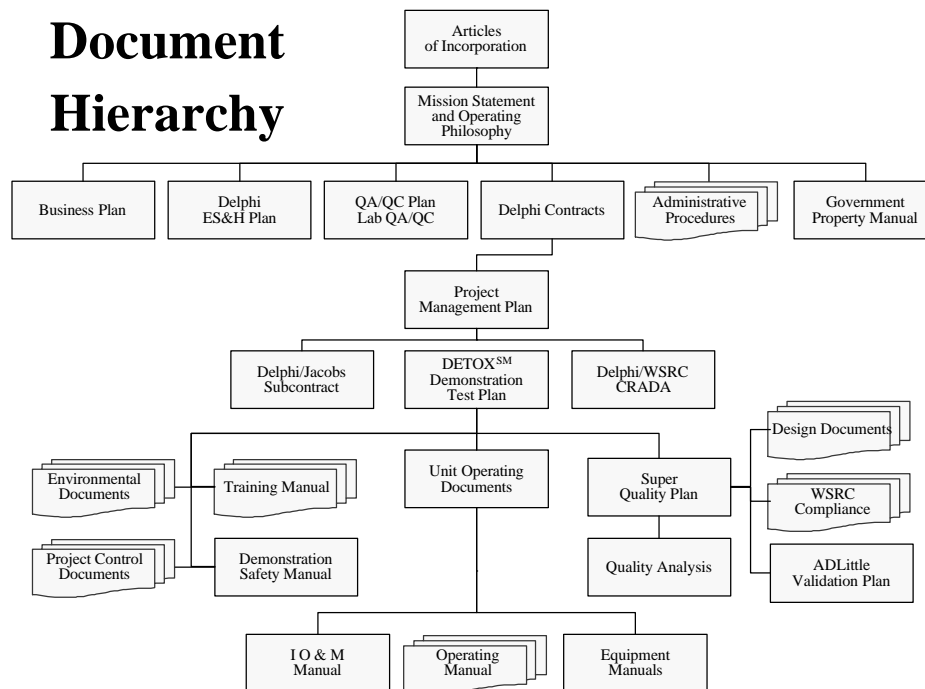
One of the more difficult issues to be addressed has been the task of discovering what the total list of site requirements are, consists of, and how the site goes about the business of accomplishing work. In the process of acquiring the new task of installing and hooking up the unit, issues regarding labor agreements became paramount to defining not only what was required to perform the work, but who is qualified to perform the work. Legal interpretation, meetings with labor leaders, and delineation of what a small independent business contracting with DOE, can or cannot do at a DOE site resulted in additional delays and frustration in trying to move a project forward.

Regarding site requirements, the actual list of issues regarding policies, procedures, and documentation were revealed on a day to day basis depending upon the planned work activity. Thus, the evolution of plans, manuals, and procedures took place over a six to twelve month period making planning impossible and the integration and overlapping of documents a management nightmare. Only when the specific lines of inquiry were devised in preparation for the Readiness Review, did the complete picture of Site Integration emerge. Documentation was recorded in twenty-five major documents shown in Figure 3 (Document Hierarchy).

The backbone of the project is driven by the Delphi contract with DOE-FETC, the Management Plan, Demonstration Test Plan, and Unit Operating Documents. Quality Assurance issues are addressed in all documents but are tied together in the Super Quality Plan for the project.

The ability to manage and implement the procedural aspects of the demonstration is governed in part by a change management plan and a robust QA program. Delphi interfaces with at least seventeen different organizations and offices in meeting the performance objectives outlined in this documentation.

Figure 3: Document Hierarchy



Site Selection for LLMW Demonstration

In Phase II of the project, a survey of sites, waste types, and site treatment plans was made to assess the candidate sites for supporting a DETOXSM demonstration. Three sites were selected, Savannah River Site (SRS), Weldon Spring Site Remedial Action Project (WSSRAP), and Rocky Flats Environmental Technology Site (RFETS). A two part demonstration was proposed with SRS being chosen as the host site for hazardous materials treatment and WSSRAP for low level mixed waste treatment. Design meetings concluding the Title II design were held with WSSRAP and SRS representatives in attendance to ensure that each of the site requirements were addressed in the design and fabrication of the unit. In December of 1995, WSSRAP announced that they would be withdrawing from the program due to the fact that no funding for Phase IV had been committed to the demonstration project and that an opportunity had arisen whereby waste proposed to be treated by DETOXSM could be sent to Oak Ridge for incineration. The alternative site, RFETS, was then contacted and the effort begun to address site requirements, location of the unit, permitting, and compliance issues. Delphi prepared the RD&D application, addressed configuration issues associated with building and site restrictions, as well as issues associated with the training of personnel in handling and treating LLMW. In the Summer of 1996, MWFA levied the requirement that RFETS commit funds to support the project. In order to support this requirement, Kaiser-Hill initiated several studies to verify the utility of the project and that it would pose an economic benefit to the site. Reports issued substantiated that the demonstration

would treat a variety of problematic wastes and that there were on-going applications beyond demonstration which would make DETOXSM useful for the site. However, in June of 1997, DOE-RFFO and Kaiser-Hill representatives announced that the demonstration would not be supported due to the fact that the waste types chosen for demonstration had been rescheduled for treatment no sooner than FY2002.

With Phase IV scheduled to commence in January of 1998, the site selection effort is being renewed to locate and secure a host site to support the demonstration of DETOXSM in treating LLMWs.

Site Integration - Recommendations for Future Demonstrations

Barriers to successful demonstration projects are many. In this demonstration project, experiences that have resulted in scope growth, schedule slippages, and unanticipated budgetary adjustments provide insight as to what might be changed to improve future demonstration projects.

1. The management of a demonstration project is complex and can be overwhelming for a small business whose focus is, and should be, technology development and commercialization, not attempting to resolve the management and communication issues within government and M&O contracting organizations.
 - **Recommendation** DOE (EM-50 or FETC) needs to define the roles, responsibilities, and a single line of authority for all participants in the demonstration project, in order for the technology developer to efficiently communicate with all priority stakeholders and effectively respond in meeting the performance objectives of the project according to contract.
2. Securing the commitment from DOE end users to support demonstration projects is ill-defined and puts at risk a great deal of invested time and money in determining compliance and funding issues.
 - **Recommendation** DOE-EM50 needs to integrate not only the needs of potential users, but principal users who can buy-in to the technology and commit to its support during demonstration. Further, the commitment to support a demonstration must be manifested in the commitment of funds, or at least in the allocation of budgets for future fiscal years.
3. Once selected, determining the actual requirements to install equipment, interface with utilities, site communications and equipment, delineation of tasks, and applicable standards and regulations are an on-going process that is more difficult than it should be. On more than one occasion, fundamental changes in applicable codes, standards, and agreements gave rise to major delays and cost adjustments that could have been avoided had the right questions been asked of the right people at the right time.

- **Recommendation** DOE-FETC and representatives of DOE field offices need to be more involved in assisting the technology developer to determine applicable requirements for a demonstration project.

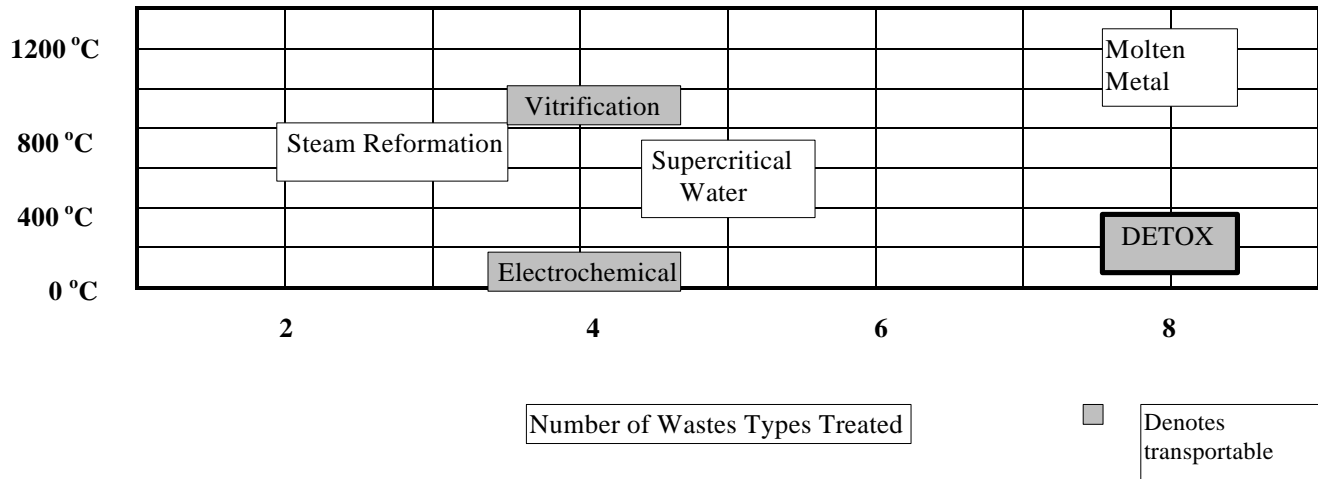
Commercialization Initiatives

Delphi has developed a business plan and strategy for the commercialization and deployment of its DETOXSM technology. The mission statement defining this effort was formulated in the Dawnbreaker program sponsored by DOE and is as follows:

Delphi Research, Inc. offers research and development services, licenses, plants, and operating and maintenance services related to the use of its patented DETOXSM technology in treating the broadest range of mixed and hazardous wastes on-site for small volume storage and small volume generator facilities within government and commercial sectors.

The technology is defined in terms of its benefits and advantages compared to leading competing technologies. DETOXSM can be discriminated from other technologies by virtue of its relatively low temperature of operation, the broad category of wastes which it can treat, and its transportability features. (See Figure 4).

Figure 4: Technology Comparison

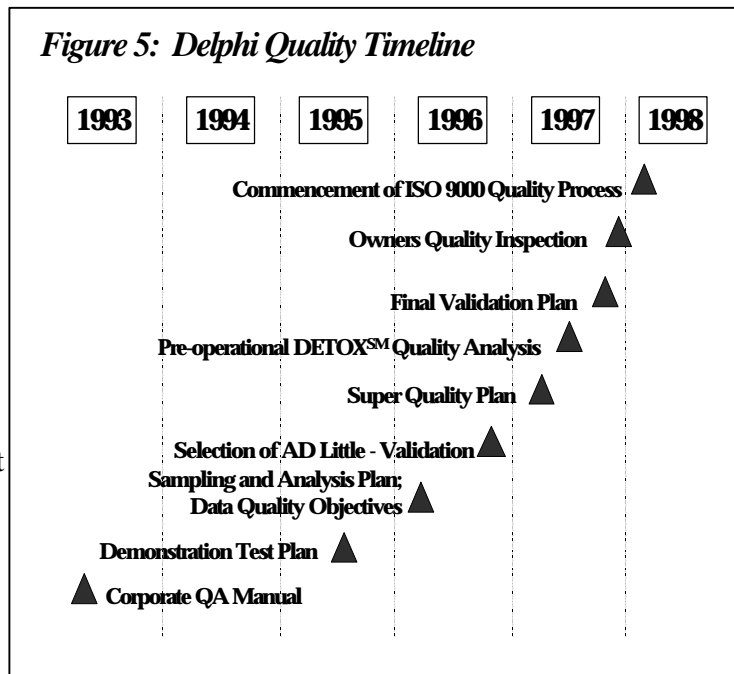


Potential customers and strategic partners have been contacted and are scheduled to visit the demonstration unit at SRS once operations begin. Although specific wastes and applications have been identified for the industrial sector, validated operational data from the demonstration unit will be required to prove the effectiveness and economics of the technology.

In anticipation of the demonstration meeting or exceeding data quality objectives and economic criteria for customers, Delphi initiated a program to become ISO 9000 and 14000 certified by the first quarter of 1998. The adjacent timeline shows the progress made to date in attaining that goal.

NOTE: The preparation of documents, training, and management control programs embodied in the DOE-FETC PRDA program to demonstrate advanced treatment technologies have resulted in approximately 80-90% of the ISO requirements being satisfied.

Figure 5: Delphi Quality Timeline



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